REMARKS

I.   STATUS OF THE APPLICATION

Claims 1-32 were submitted for examination. Claims 5, 6, 9, and 10 were previously

deleted without prejudice and claims 1-4, 7, 8, 11-32 remain in the case. Claims 1-4, 7, 8, 11-19,

and 21-32 stand rejected by the Examiner. Claim 20 stands allowed.

Claims 1-2, 15-19, 21 and 28-32 stand rejected under 35 U.S.C. § 102(e) as being

anticipated by Weinberger, et al. (US PAT. 6,453,389, hereinafter "Weinberger"). Claims 3-4

and 22-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Weinberger in

view of Tipley, et al. (US PAT. 5,325,504, hereinafter "Tipley"). Claim 7 stands rejected under

35 U.S.C. § 103(a) as being unpatentable over Weinberger in view of Kurokawa, et al. (JP 04-

367984, hereinafter "Kurokawa"). Claim 8 stands rejected under 35 U.S.C. § 103(a) as being

unpatentable over Weinberger in view of McNutt, et al. (US PAT. 5,606,688, hereinafter

"McNutt"). Claims 11-14 and 25-27 stand rejected under 35 U.S.C. § 103(a) as being

unpatentable over Weinberger in view of Dixion, et al. (US PAT. 4,490,782, hereinafter

"Dixion"). The Office Action does not specifically address claim 24. Applicant respectfully

traverses the rejections of the claims of the present invention.

II.   BACKGROUND

Initially, it may be instructive to review the claimed invention described in the present

application and the disclosures of the prior art. In general, the present application describes a

system and method that relates to prefetching a stream of sequential data for a preexisting cache

system. The present invention relies on remotely modeling the dynamic operation of the

preexisting cache system. To accomplish this, the claimed invention may remotely intercept data

requests from a host to a cache and request that additional data elements be stored in the cache. In this way, the present invention may selectively prestage data elements into an existing LRU cache without modification to the preexisting cache. The present invention may be installed on an existing system not designed originally to support a prefetcher.

The present invention remotely models the operation and contents, if known, of the preexisting cache. The remote model is used to predict data elements not currently resident in the cache that may subsequently be requested. As discussed in Applicant's previous response to the initial Office Action, the applicable definition of "model," as provided by www.dictionary.com and used in claim 1, is "a work or construction used in testing or perfecting a final product." This definition is established by the recitation of "making a cache management decision based upon the model" in claim 1. The model spoken of in claim 1 is not simply a representation of the cache, but is used to tune the dynamic operation of the cache by making cache management decisions.

The enabling description of the present application further describes modeling. Figure 2 depicts a remote modeling module (210) within a prefetch module (200). The remote modeling module described contains objects (230) that preferably contain information about individual data elements within the cache. In the description provided, these objects may include header information priority values, time stamps, and markers that all describe one or more data elements within the cache. The depicted remote modeling module also includes alternate models (220) that are related to a dynamic threshold value that may be used to model the performance of the preexisting cache, such as by predicting when a data element might "fall out" of the cache or when sequential data elements might be prestaged into the cache.

In contrast, Weinberger teaches optimizing cache performance through prefetching by using a cache (14), a prefetcher (16), and a prefetch cache memory (18). The prefetch cache memory is disclosed to "access previous cache misses" (col. 5, lines 1-5; col. 5, lines 45-52) and may also contain "dirty lines" (col. 6, lines 26-36) that have "fallen out" of the cache due to infrequent access by a host. In this way, the prefetch cache memory may be used as a "victim cache."

Weinberger also discloses building a "data structure" based on address differences between cache misses and rough predictions. In other words, Weinberger discusses predicting the storage location of data subject to a cache request and then calculating an address difference between the predicted location and the actual location of the requested data when there is a cache miss. Weinberger primarily teaches the building of the data structure based on the accumulated stall time produced by cache misses (col. 2, lines 20-47; col. 7, line 62 – col.8, line 59).

However, Weinberger does not teach or disclose remotely modeling the dynamic operation or the contents of a preexisting cache, including providing a model of the data elements stored within the cache, and making a cache management decision based on the remote model. In fact, Weinberger focuses on prefetching data elements based on cache misses—data elements that were requested but never stored in the cache—rather than on any model of the data elements within the cache.

III.   RESPONSE TO THE REJECTIONS

With respect to claims 1-2, 15-19, 21 and 28-32, Applicant respectfully asserts that the Office Action does not establish a *prima facie* case of anticipation. To establish a rejection under 35 U.S.C. § 102(e), all claim limitations must be disclosed in a single prior art reference. See

MPEP § 2131 and *Verdegaal Bros. v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). Significant limitations of Applicant's independent claims are not found in Weinberger and, consequently, a *prima facie* case of anticipation has not been established.

A.   INDEPENDENT CLAIM 1

With particular regard to the rejection under 35 U.S.C. § 102(e) of claim 1, Applicant respectfully asserts that Weinberger does not disclose each and every element of the claimed invention. The Office Action states that Weinberger discloses "remotely modeling dynamic operation of the cache" in the abstract and at col. 2, lines 20-47. The cited prior art references generally discuss a data structure built upon the address difference between a predicted cache request and an actual cache request when there is a cache miss.

The cited references do not disclose modeling the dynamic operation of a cache as claimed in the present invention. Specifically, the cited references do not model data elements within a cache, but rather relate to <u>cache</u> <u>misses</u> that refer to data references that are explicitly <u>not</u> within the cache. There is no disclosure in the Weinberger references that discusses modeling the dynamic operation of the cache. Weinberger does mention that the data structure is "adaptive" and may be maintained in a "dynamic fashion," but this describes a characteristic of the data structure—the data structure may be dynamic or adaptive—and does not inherently relate to dynamic operation of the cache.

The Office Action also states that Weinberger discloses "providing a model of data elements stored within the cache" at col. 5, lines 1-5. Once again, the Weinberger reference specifically states that "the prefetcher 16 has access to previous <u>cache</u> <u>misses</u> *only* rather than the whole set of memory addresses" (emphasis added). It is a logical impossibility to expect the

prefetcher of Weinberger, with access limited to cache misses only, to store sequential data that is either within the cache (modeling) or that has not been requested but may be requested by the cache at a future date (sequential prefetching). Clearly, the Office Action misapplies the cited reference, which does not anticipate "providing a *model of data elements stored within the cache*" (emphasis added) as claimed in the present application.

Also, with regard to the rejection of claim 1, the Office Action states that Weinberger discloses "making a cache management decision based upon the model" at col. 5, lines 42-63. The cited reference discusses use of the prefetcher (16) to request a cache line from the prefetch cache memory (18). The cache line is stored in the prefetch cache memory as a result of a cache miss "[i]f the cache 14 does not store the requested cache line." Even if the method described did make a decision to store the data of the cache miss in the prefetch cache memory, it does not make any decisions based upon any kind of model as claimed in the present application. Weinberger simply stores data to a secondary cache (prefetch cache memory 18) if a cache miss occurs while attempting to store the data in a primary cache (cache memory 14). After the initial, or primary, cache miss, the prefetcher may add the requested data to the cache memory if the data is within the prefetch cache memory, or may also return a subsequent, or secondary, cache miss. There is no model or cache management decision disclosed by the Weinberger reference.

B.   INDEPENDENT CLAIM 21

Applicant's traversal of the rejection of independent claim 21 follows similar reasoning as presented above with respect to the rejection of claim 1. The Office Action states that Weinberger discloses a cache, a remote prefetch module, and a modeling module, each having the limitations enumerated in claim 21, in the abstract and at col. 5, lines 1-63. Applicant asserts

that Weinberger does not disclose a remote prefetch cache module or a modeling module as claimed in the present application. Applicant sees no need to address in detail the issue of the cache as claimed given the enumerated distinctions between the prefetch cache and modeling modules and the cited prior art references.

The Office Action states that Weinberger discloses a "prefetch cache module configured to communicate with the host and the cache and configured to determine whether to schedule a prefetch of data into the cache" in the form of the prefetcher (16). As described above, the prefetcher of the cited prior art reference does not make any determination whether to schedule a prefetch of data into the cache. The prefetcher simply attempts to store a requested cache line in the prefetch cache memory in response to a cache miss. The prefetcher does not make any determinations as to scheduling a prefetch of data into the cache where the prefetch is an anticipated data element that has not been requested but is predicted to be requested at a future time. The name "prefetcher," as employed in the prior art, is actually a misnomer because the functions performed by the prefetcher are subsequent to an initial cache request and cache miss. The prefetcher works in response to cache misses rather than in predictive scheduling of data elements. In this way, the prior art prefetcher does not anticipate the remote prefetch module of the claimed invention.

The Office Action also states that Weinberger discloses a "modeling module operating within the prefetch module configured to model the cache" in the form of the prefetch cache memory (18). As described above, the prefetch cache memory of the prior art is simply a secondary cache memory for storing data associated with a cache miss. The prefetch cache memory is neither disclosed nor enabled to perform any type of cache modeling that is described

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and claimed in the present application. Rather, as explained above, the prefetch cache memory stores data from cache misses and possibly also stores victim data that has fallen out of the primary cache memory, which data is in no way representative or modeling of the data stored in the primary cache. The data stored in the prefetch cache memory is actually memory that is <u>not</u> stored in the cache memory specifically because it was either a cache miss or a cache line victim. Given that the prefetch cache memory of the prior art does not model the cache, it cannot serve as the anticipatory basis for a 35 U.S.C. § 102(e) rejection.

C. INDEPENDENT CLAIM 29

Applicant's traversal of the rejection of independent claim 29 follows similar reasoning as presented above with respect to the rejection of claim 1. The Office Action states that Weinberger discloses a modeling module and a calculation module, each having the limitations enumerated in claim 29, in the abstract and at col. 4, line 40 – col. 6, line 65. For the reasons set forth above, Applicant asserts that Weinberger does not disclose a modeling module as claimed in the present application.

With regard to the assertion that Weinberger discloses a "calculation module configured to make a cache management decision based upon the model" in the form of the arithmetic logic unit (17), Applicant respectfully disagrees. The assertion is without any foundation given that the only reference applicants can locate within the cited prior art to the arithmetic logic unit is provided as follows, "The prefetcher 16 is a second CPU including a suitably programmed arithmetic logic unit 17. The arithmetic logic unit 17 is programmed to manipulate data." (col 4, lines 57-59). Even if the arithmetic logic unit of Weinberger were intended to make a cache

management decision based upon a model, which Applicant strongly disbelieves, there is absolutely no support in the cited reference to make such an assertion.

The arithmetic logic unit is not even disclosed to interact with the cache memory, prefetcher, or prefetch cache memory of the prior art, let alone any module or element that creates, supports, manages, updates, or relates to models of the data elements within a cache. Even if it were assumed, improperly so, that the arithmetic logic unit interacts with the cache memory, prefetcher, or prefetch cache memory, there is no suggestion or enabling description that discloses the arithmetic logic unit to be capable of making a cache management decision based upon a model of the dynamic operation of the cache. There is no substantive support in the Office Action or referenced prior art for the rejection under 35 U.S.C. § 102(e) of independent claim 29.

D.   OTHER INDEPENDENT CLAIMS

Applicant respectfully asserts that the arguments presented above in support of independent claim 29 also support withdrawal of the rejection under 35 U.S.C. § 102(e) of independent claim 30. Likewise, Applicant respectfully asserts that the arguments presented above in support of independent claim 1 also support withdrawal of the rejection under 35 U.S.C. § 102(e) of independent claim 31. Furthermore, Applicant respectfully asserts that the arguments presented above in support of independent claim 21 also support withdrawal of the rejection under 35 U.S.C. § 102(e) of independent claim 32.

IV.   SUMMARY

The Federal Circuit has held that the cited prior art must disclose each and every element of the claim sufficiently to demonstrate its existence in the prior art. *Motorola, Inc. v.*
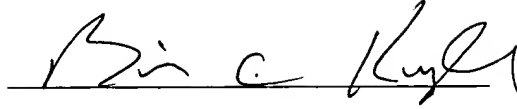
Interdigital Tech. Corp., 43 USPQ 2d 1481, 1490 (Fed Cir. 1997). Applicant respectfully asserts that the prior art references cited in the Office Action do not sufficiently demonstrate the existence of the elements of the claimed invention within the prior art disclosure. As such, the Office Action does not establish a *prima facie* case of anticipation necessary to support the rejection under 35 U.S.C. § 102(e). Applicant respectfully requests withdrawal of the rejection under U.S.C. § 102(e) of claims 1-2, 15-19, 21 and 28-32.

As a result of the presented remarks, Applicant asserts that independent claims 1, 20, 21, 29, 30, 31 and 32 are in condition for prompt allowance. Applicant has not specifically traversed the rejections of dependent claims 2, 15-19, and 28 under 35 USC § 102(e) or the rejections of dependent claims 3, 4, 7, 8, 11-14, 22, 23, and 25-27 under 35 U.S.C. § 103(a), each of which depends from independent claims 1 and 21, but believes those claims to be allowable for depending from allowable independent claims.

Should additional information be required regarding the traversal of the rejections of the claims enumerated above, the Examiner is respectfully requested to notify Applicant of such required information. If any impediments to the prompt allowance of the claims can be resolved by a telephone conversation, the Examiner is respectfully requested to contact the undersigned.

Respectfully submitted,

Brian C. Kunzler
Reg. No. 38,527
Attorney for Applicants

Date: June 17, 2003
10 West 100 South
Suite 450
Salt Lake City, UT 84101
Telephone (801) 994-4646
Fax (801) 531-1929